Available online at www.sciencedirect.com
ScienceDirect
Procedia - Social and Behavioral Sciences 136 (2014) 452 – 456
Procedia
Social and Behavioral Sciences

LINELT 2013

Determination Of Knowledge And Misconceptions Of Pre-Service Elementary Science Teachers About The Greenhouse Effect By Drawing

Dilek ÇELİKLER [a]*,Zeynep AKSAN [b]

[a] *Ondokuz Mayıs University Faculty of Education, Primary Education Department, Samsun, Turkey*
[b] *Ondokuz Mayıs University, Institute of Education Sciences, Samsun, Turkey*

Abstract

In this study, we aimed to determine pre-service elementary science teachers' knowledge about the greenhouse effect by drawing to determine the misconceptions they have and to classify their level of knowledge. This study was carried out with 71 pre-service teachers studying for their third year at the Science Education Department in the Faculty of Education at a state university in Turkey. In the study, the pre-service teachers were asked to put forward their knowledge about the greenhouse effect by drawing and writing. The obtained drawings and written statements were evaluated with descriptive analysis of the answers given to the questions carried out by dividing them into groups based on six different levels, as used by Kara (2007). According to the results of the research, it has been observed that pre-service teachers have inadequate knowledge and misconceptions about the greenhouse effect.

Selection and peer-review under responsibility of the Organizing Committee of LINELT 2013.

Keywords: Greenhouse effect, drawing, pre-service elementary science teacher

1. Introduction

Looking at the natural factors of climate system, the greenhouse effect appears to be the most important factor of the system. The natural greenhouse effect that provides the heat balance of the world is an essential element for life. The natural greenhouse effect can be described as a natural process, which is essential for life to exist in the world, providing the required level of heat and regulating the heat balance of the world. This is because the gasses in the atmosphere are permeable to the incoming solar radiation, but are much less permeable to the long-wave radiation

*Corresponding Author: Dilek Çelikler, GSM: 05323850990
E-mail address: dilekc@omu.edu.tr

Selection and peer-review under responsibility of the Organizing Committee of LINELT 2013.
doi:10.1016/j.sbspro.2014.05.355

that is emitted back (Türkeş, 2001). From the industrial revolution to the present day, due to a rapid increase in the amount of greenhouse gasses emitted into atmosphere by human activities such as the burning of fossil fuels, deforestation, agricultural activities and industrial processes, the strengthening of the natural greenhouse effect due to urbanization causes temperature increases on the earth (Türkeş, 2006), which jeopardises our lives. Today, considering that the most important environmental problem that threatens the world is global warming as a result of the increasing greenhouse effect, it shows how important the greenhouse effect is in environmental education.

The concepts that have an important role in science teaching are not concrete goods, events or entities, but rather they are abstract thought units reached when we collect them into certain groups (Ayas & Özmen, 1998; Karamustafaoğlu, Karamustafaoğlu & Yaman, 2005). As the concepts are the abstract thought units, students make mistakes when configuring the concepts (Treagust, 1988; Aydoğan, Güneş & Gülçiçek, 2003). This situation, known as a misconception, appears to be an important problem in education. If the concepts are considered to have an important role in science education, it has been observed how important the identification and removal of the students' misconceptions are.

Drawing is important to reveal the students' knowledge, misconceptions and conceptual changes on a particular topic, without being limited to words (White & Gunstone, 1992; Ayas, 2006). Drawing is more efficient in revealing thought changes as it takes less time to describe, contains a lot of information and is assimilated easily (Atasoy, 2004). In addition, through drawing the knowledge and beliefs hidden in the students are revealed without being dependent on the words (Ayas, 2006) and students who do not like to answer can answer questions easily and quickly whilst having an enjoyable time (Thomas & Silk, 1990).

When the literature is examined, it has been seen that drawing was used in many studies to reveal students' existing knowledge and misconceptions (Prokop & Fancovicová, 2006; Acar & Tarhan, 2008; Bartoszeck et. al., 2008; Kara et. al., 2008; Köse, 2008; Uzunkavak, 2009a, 2009b; Çelikler & Topal, 2011; Çelikler & Kara 2012). This study aims to determine the pre-service teachers' knowledge about the greenhouse effect through drawing, to determine misconceptions they have and classify their knowledge levels.

2. Method

This study was carried out with 71 pre-service teachers studying for their third year at the Science Education Department in the Faculty of Education at a state university in Turkey. In the study, pre-service teachers were asked to describe the greenhouse effect by drawing and writing. The obtained drawn and written explanations were evaluated using descriptive analysis by dividing them into groups based on six different levels as used by Kara (2007). Levels used in the evaluation of data are given in Table 1.

Table 1. A six level evaluation table to evaluate theoretical knowledge and drawings about the greenhouse effect

Levels	Statements
Level 1	No Theoretical Knowledge/Drawing
Level 2	Wrong Theoretical Knowledge/Drawing
Level 3	Partly Wrong And Inadequate Theoretical Knowledge/Drawing
Level 4	Theoretical Knowledge/Drawing With Misconceptions
Level 5	Accurate But Incomplete Theoretical Knowledge/Drawing
Level 6	Completely Accurate And Perfect Theoretical Knowledge/Drawing

3. Findings

In this study, the pre-service science teachers were asked to put forward their knowledge about the greenhouse effect by drawing and writing. The pre-service teachers' knowledge levels and misconceptions were determined by analysing their explanations and drawings related to the greenhouse effect. The data obtained from the pre-service teachers' explanations and drawings is given in Table 2.

Table 2. Evaluation results of theoretical knowledge and drawing regarding greenhouse effect

Levels	Statements	Theoretical Knowledge		Drawing	
		f	%	f	%
Level 1	No Theoretical Knowledge/Drawing	19	27	9	13
Level 2	Wrong Theoretical Knowledge/Drawing	5	7	33	47
Level 3	Partly Wrong And Inadequate Theoretical Knowledge/Drawing	19	27	18	25
Level 4	Theoretical Knowledge/Drawing With Misconceptions	11	15	11	15

Level 5	Accurate But Incomplete Theoretical Knowledge/Drawing	17	24	0	0
Level 6	Completely Accurate And Perfect Theoretical Knowledge/Drawing	0	0	0	0

According to Table 2, it was estimated that 27% of the pre-service teachers did not write any theoretical knowledge. It was found that 7% of the pre-service teachers who wrote theoretical knowledge were in level 2; 27% of them were in level 3; 15% of them were in level 4; and 24% of them were in level 5. It was determined that none of the pre-service teachers expressed the greenhouse effect completely and accurately. It was identified that 47% of the pre-service teachers' drawings were in level 2, 25% of the pre-service teachers' drawings were in level 3 and 15% of the pre-service teachers' drawings were in level 4. In addition, it was identified that there was not a teacher who drew the greenhouse effect correctly, accurately and completely.

Table 3. Misconceptions about the greenhouse effect

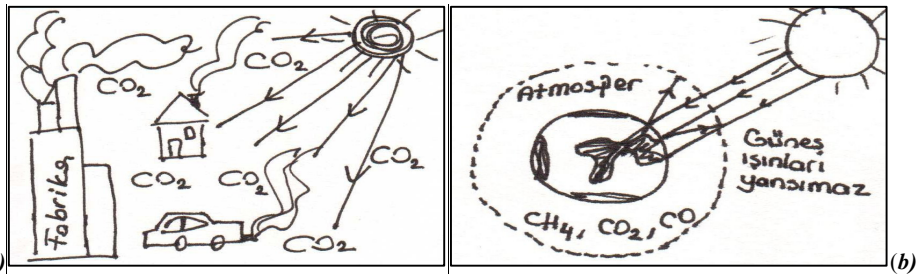
Misconceptions	**f**
Ozone layer depletion	8
Vegetable glasshouse	2
Sea pollution	1
Acid rain	1

According to Table 3, it was found that eight pre-service teachers associated the greenhouse effect with the thinning of the ozone layer, two pre-service teachers associated the greenhouse effect with the greenhouses used in agriculture, one pre-service teacher associated it with water pollution and one pre-service teacher associated it with acid rain. Wrong theoretical knowledge that is an example for level 2 is as follows:

"*The universe becomes hot with the rays coming from the Earth. These rays are gasses such as CO_2 and methane. These being kept in the atmosphere is called greenhouse effect."*

The pre-service teacher gave a wrong answer stating that the universe gets warm by the rays coming to the earth, and that these rays are gasses such as CO_2, methane and that the greenhouse effect occurs by keeping these gasses in the atmosphere.

The sample drawing for level 2 is shown in Fig.1*(a)*. The knowledge and drawing sample for level 3 from the answers given by the pre-service teachers is given in Fig.1*(b)*.



(a) ***(b)***

Fig.1. Irrelevant wrong drawing that is an example for level 2 *(a)*; partly wrong and inadequate drawing that is an example for level 3 *(b)*

When Fig.1*(a)* is examined, it can be seen that the pre-service teachers made an incorrect drawing of the greenhouse effect in the form of the rays from the sun in the presence of an environment of CO_2 and then returned to the sun.

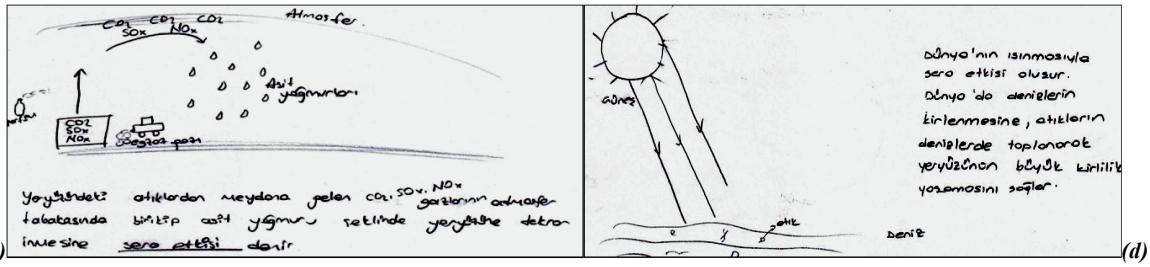
When Fig.2*(b)* is examined, the pre-service teacher stated that the rays coming to the Earth's surface cannot reflect into the space because of the accumulated carbon in the air block it and this situation creates the greenhouse effect. It is observed from the pre-service teacher's statement that they have incorrect knowledge about the greenhouse gasses, yet the pre-service teacher's implications regarding the rays coming to the Earth cannot reflect back into space are true.

Partly wrong and inadequate theoretical knowledge that is an example for level 3 is as follows:

"*Because of C accumulated in the air, the rays that should be reflected into space are blocked and come back to the Earth's surface, which causes the greenhouse effect."*

When theoretical knowledge (level 3) is examined, it has been observed that the pre-service teacher made a partially incorrect drawing about how each of the beams from the sun reflect back to the Earth.

The information and drawing sample for level 4 among the pre-service teachers' answers is given in Fig.3 *(c,d)* and Fig.4*(e,f)*.

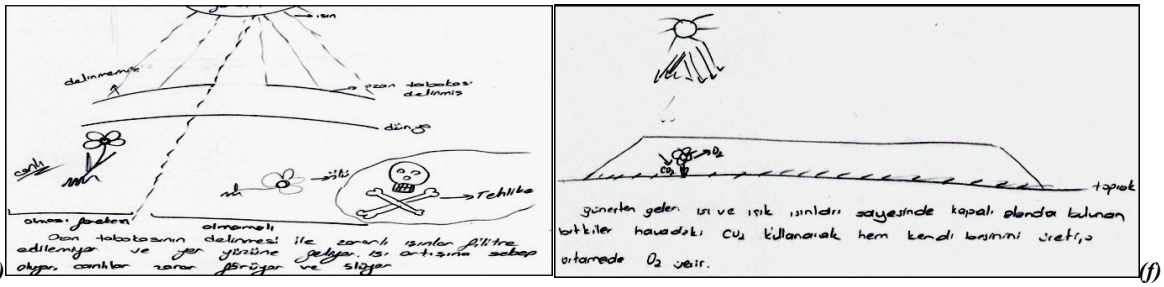


(c) *(d)*

Fig. 2. Theoretical knowledge and drawing with misconceptions (Acid rain *(c)*-Sea pollution *(d)*) that are examples for level 4

When Fig.2*(c)* is examined, it can be seen that the pre-service teacher explained the greenhouse effect as the formation of acid rain and made a drawing according to this explanation.

When Fig.2*(d)* is examined, it can be seen that the pre-service teacher explained the greenhouse effect as an event that has occurred as the result of the world's warming and expressed as a cause for the pollution of the seas in the world.



(e) *(f)*

Fig. 3. Theoretical knowledge and drawing with misconceptions (Ozone layer depletion *(e)*-Vegetable glasshouse *(f)*) as examples for level 4

When Fig.3*(e)*is examined, it can be observed that the pre-service teacher associated the greenhouse effect with ozone layer depletion. The pre-service teacher explained the greenhouse effect as being a result of the harmful rays not being filtered due to ozone layer depletion and, therefore, it causes an increase in temperature as more rays reach the Earth. When the pre-service teacher's drawing is looked at, it can be observed that the pre-service teacher made a drawing to support his/her explanation. It is seen in the drawing that when the ozone layer is damaged, living creatures die; when the ozone layer is not damaged, living creatures are not hurt.

When Fig.3*(f)*is examined, it can be seen that the pre-service teacher drew agricultural greenhouses in his/her drawing. It has been determined that the pre-service teacher explained the greenhouse effect as agricultural greenhouses in his/her written explanations.

Accurate but incomplete theoretical knowledge that is an example for level 5 is as follows:

"After the sun's rays are reflected from the Earth's surface, the sun's rays are kept by CO_2 and water vapour in the atmosphere. The greenhouse effect is a natural event. Temperature increases as a result of increasing greenhouse gasses"

When theoretical knowledge (level 5) is examined, it can be seen that the pre-service teacher explained the greenhouse effect as an increase in temperature as a result of rays from the sun to the Earth being kept in by CO_2, water vapour and other materials. In addition, the pre-service teacher indicated that the greenhouse effect is a natural event and the factors increasing the greenhouse effect are CO_2 and water vapour. It can be seen that the pre-service teacher knew the mechanism of the greenhouse effect correctly but had incomplete information about greenhouse gases.

Results

As a result of the study, it was determined that 47% of the pre-service teachers' drawings were in level 2, 25% of the pre-service teachers' drawings were in level 3, and 15% of the pre-service teachers' drawings were in level 4; no teacher drew the greenhouse effect correctly, but rather drew it incompletely and not totally accurately. Also, it has been identified that 27% of the pre-service teachers did not write any theoretical knowledge and 7% of the pre-service teachers who wrote theoretical knowledge were in level 2; 27% of them were in level 3, 15% in level 4 and 24% of them were in level 5. It has been observed that there was no teacher who expressed the greenhouse effect completely and wholly accurately. It has been identified that some of the pre-service teachers explained and associated the greenhouse effect with the thinning of the ozone layer, greenhouses used in agriculture, water pollution and acid rain. These results have shown that the pre-service teachers did not have enough information about the greenhouse effect and had some misconceptions related to the greenhouse effect. According to the results of the study, drawing appears to be quite effective in determining the information and misconceptions relevant to a particular subject and to manifest the information about a particular subject without limiting it to words. When the studies in which students' knowledge was assessed are examined, it was concluded that through drawing the information students have about: the organs in body (Bartoszeck et al., 2008); carbon dioxide and the water cycle (Çelikler and Topal, 2011); the periodic table (Çelikler and Kara, 2012); the concept of light (Kara et al., 2008); photosynthesis and respiration in plants (Köse, 2009); Newton's laws (Uzunkavak, 2009a); and business concepts (Uzunkavak, 2009b) could be evaluated in a meaningful way. As a result, today, in the teaching of the greenhouse effect, which is one of the most important environmental issues, meaningful and lasting teaching should be provided by using student-centred teaching methods and techniques, resolving the students' missing information and eliminating their misconceptions.

References

Acar, B., & Tarhan, L. (2008). Effects of cooperative learning on students' understanding of metallic bonding. *Resarch in Science Education. 38,* 401-420.

Ayas, A., & Özmen, H. (1998). Asit-baz kavramlarının güncel olaylarla bütünleştirilme seviyesi: bir örnek olay çalışması, *III. Ulusal Fen Bilimleri Eğitimi Sempozyumu*, Trabzon.

Aydoğan, S., Güneş, B., & Gülçiçek, Ç. (2003). Isı ve sıcaklık konusunda kavram yanılgıları. *Gazi Üniversitesi Gazi Eğitim Fakültesi Dergisi. 2,* 111-124.

Atasoy, B. (2004). *Fen ve teknoloji öğretimi*. Ankara: Asil.

Bartoszeck, A. B., Machado, D. Z., & Amann-Gainotti, M. (2008). Representations of internal body image: A study of preadolescents and adolescent students in Araucaria, Paraná, Brazil. *Ciências & Cognição. 13(2),* 139-159.

Çelikler, D., & Topal, N. (2011). İlköğretim fen bilgisi öğretmen adaylarının karbondioksit ve su döngüsü konusundaki bilgilerinin çizim ile saptanması. *Journal of Educatıonal and Instructıonal Studıes In The World. 1(1)*.

Çelikler, D., & Kara, F. (2012). İlköğretim fen bilgisi öğretmen adaylarının periyodik çizelge konusundaki bilgilerinin çizim yoluyla saptanması. *Journal of Research In Education and Teaching. 1(3)*.

Kara, İ. (2007). Revelation of general knowledge and misconceptions about Newton's laws of motion by draving method. *World Applied Sciences Journal. 2(S)*, 770-778.

Kara, İ., Avcı, E. D., & Çekbaş, Y. (2008). Fen bilgisi öğretmen adaylarının ışık kavramı ile ilgili bilgi düzeylerinin araştırılması. *Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi.* 46-57.

Karamustafaoğlu, S., Karamustafaoğlu, O., & Yaman, S. (2005). *Fen ve Teknoloji Öğretimi.* M. Aydoğdu, & T. Kesercioğlu (Ed.).Ankara: Anı.

Köse, S. (2008). Diagnosing student misconceptions: Using drawings as a research method. *World Applied Sciences Journal. 3(2)*, 283-293.

Prokop, P., & Fancovicová, J. (2006). Students' ideas about the human body: Do they really draw what they know? *Journal of Baltic Science Education. 2(10)*, 86-95.

Thomas, G. V., & Silk, A. M. J. (1990). *An introduction to the psychology of children's drawings*. Hemel Hempstead: Harvester Wheat Sheaf.

Treagust, D. F. (1988). Development and use of diagnostic tests to evalute students' misconceptions in science. *International Journal of Science Education. 2*, 159-169.

Türkeş, M. (2001). Hava, iklim, şiddetli hava olayları ve küresel ısınma. *Devlet Meteoroloji İşleri Genel Müdürlüğü 2000 Yılı Seminerleri*. 1, 187-205.

Türkeş, M. (2006). Küresel iklimin geleceği ve Kyoto Protokolü. *Jeopolitik. 29*, 99-107.

Uzunkavak, M. (2009a). Öğrencilerin newton kanunları bilgilerinin yazı ve çizim metoduyla karşılaştırılması. *SDU International Journal of Technologic Sciences. 1(1)*, 29-40.

Uzunkavak, M. (2009b). Öğrencilerin iş kavramında pozitiflik-negatiflik ayrımı becerilerinin yazı ve çizim metoduyla ortaya çıkarılması. *SDU International Journal of Technologic Sciences. 1(2)*, 10-20.

White, R. T., & Gunstone, R. F. (1992). *Probing understanding*. London: The Falmer Press.